

The Examiner's position on the prior art is set forth in detail in the Action and will not be repeated here except as needed to an understanding of Applicants' traversal.

First, Applicants would propose to amend claims 1, 6, 8, 18 and 21 by including "having an average diameter of 10  $\mu\text{m}$  or less" after "non-woven fabric". See the specification at page 15, lines 21-22, page 21, Table 1 and Examples 1-4 in the specification.

Applicants now address the rejections.

Applicants first address the anticipation rejection over Fukata.

Amended claim 1 of the present application mandates "A melt-blown, non-woven fabric having an average diameter of 10  $\mu\text{m}$  or less comprising polyarylene sulfide having a branched structure and a non-Newtonian coefficient of 1.05-1.20."

Namely, the melt-blown, non-woven PAS (PAS and PPS are used rather interchangeably herein) fabric of the present invention has an average fiber diameter of 10  $\mu\text{m}$  or less. When the average fiber diameter is in a range of 0.1-10  $\mu\text{m}$  the melt-blown, non-woven fabrics can be produced with remarkable stability as shown in Table 1, working Examples 1-4.

In contrast to the present invention, Fukata teaches a non-woven fabric made from a web of PPS filament (spun bonded fabric) having a fineness of 0.1 to 15 denier (an average diameter of ca. 1-150  $\mu\text{m}$ ), not a web by carding from a staple of PPS filaments, by subjecting the PPS filaments to separating by electrostatic charge, collecting the separated filaments on a plane, and bonding or interlocking the collected filaments (see column 1, lines 41-60, column 2, line 65 to column 3, line 5, column 5, lines 6-7, column 5, lines 37-42 (Example 1), column 6, line 60 to column 7, line 14 (Example 4)). Thus, Fukata fails to teach or suggest a melt-blown, non-woven

fabric made from ultrafine PAS fibers deposited on a collector in a melt-blowing step as disclosed in the present application.

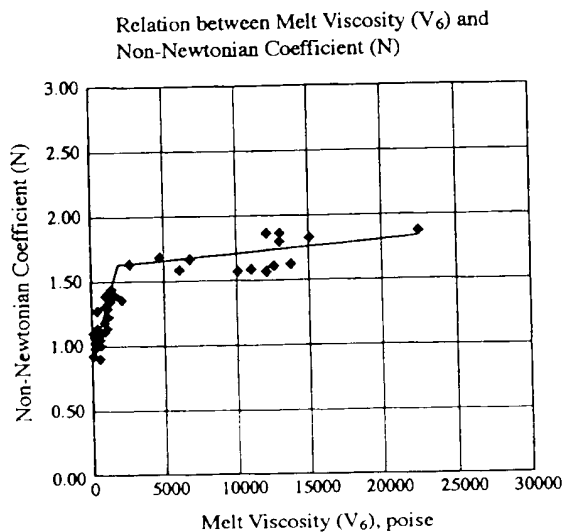
With respect to the non-Newtonian coefficient, the Examiner mentions in Paragraph 5, page 3, lines 4-7, of the Office Action that:

“Fukata does not state that the range can be anything between 0 and 100, but specifically limits the range to between .9 and 2.0. It is the examiner’s position that this is a sufficiently narrow range to [be] between .9 and 2.0.”

The above Examiner is submitted to be incorrect.

The value of the non-Newtonian coefficient in itself cannot be in the range between 0 and 100 as indicated by the Examiner. Applicants have carried out measurements of the non-Newtonian coefficient and melt viscosity with respect to various kinds of PPS polymers used in the melt-blown, non-woven fabrics, injection-molded articles and extruded goods produced in their company according to the methods for (1) Non-Newtonian coefficient (N) and (2) Melt viscosity (V6) described on page 19, line 13 to page 20, line 20 of the specification. The results are shown in Fig. 4 below.

Fig. 4



As is clear from Fig. 4, the N values of almost all kinds of the PPS polymer grades are less than 2. The N values corresponding to the region showing low melt viscosity ranging from 295 to 320 poise are equivalent to those of the PAS polymers used in the present invention.

Therefore, the non-Newtonian constant  $n$  of  $0.9 < n < 2.0$  of Fukata covers a very large range of polymer flow of almost all of the polymer structures including linear type and branched type structures.

Thus, one skilled in the art referring to Fukata would not be motivated to reach the present invention recited in amended claim 1, and, accordingly, the present invention is not anticipated by nor obvious over Fukata.

Further, amended claim 18 of the present application mandates "A melt-blown, non-woven fabric having an average diameter of 10  $\mu$ m or less comprising polyarylene sulfide having a cross-linked structure and a non-Newtonian coefficient of 1.05-1.20."

Amended claim 21 of the present application mandates "The melt-blown, non-woven fabric having an average diameter of 10  $\mu$ m or less according to claim 1 which has a non-Newtonian coefficient of 1.06-1.19.

With respect to amended claim 18, Fukata is silent regarding any method for introducing a cross-linking structure into PPS polymers. Accordingly, Fukata fails to teach a cross-linked PPS polymer having a non-Newtonian coefficient of 1.05-1.20 of the present invention. Therefore, based on the above discussion concerning amended claim 1, the invention recited in amended claim 18 is patentable over Fukata.

With respect to amended claim 21, its patentability is clear not only from the above discussion concerning amended claim 1 but also the description on page 21, lines 8-11, and working Examples 1-4 in Table 1 of the specification.

Applicants now address the obviousness rejection of claims 1, 18 and 21.

From the above discussion on claims 1, 18 and 21, it is clear that Fukata fails to teach not only a melt-blown, non-woven fabric having an average diameter of 10  $\mu\text{m}$  or less comprising PAS having a branched structure or a cross-linked structure and a non-Newtonian coefficient of 1.05-1.20 but also a melt-blown, non-woven fabric having an average diameter of 10  $\mu\text{m}$  or less comprising PAS having a branched structure and a non-Newtonian coefficient of 1.06-1.19.

With respect to Harwood, although Harwood discloses a method of preparing polyarylene sulfide fibers, particularly PPS fibers, by melt blowing a blend comprising a polyarylene sulfide and a polyolefm, wherein the polyolefin is present in an amount of 1-40%, by weight of the total blend (see column 3 lines 35-40, column 7, lines 41-47). Harwood is silent on the non-Newtonian coefficient. Further, although Harwood teaches melt blowing a blend comprising a polyarylene sulfide and a polyolefin, the melt blowing of PPS polymer alone does not operate well owing to nozzle dribble after 2 hours in Run No. 1 or leakage of molten polymer due to excess pressure at the dies caused by a cross-linked or charred material as shown in Run No. 2 in Table 3 (see Table 3 in columns 11 and 12; column 13, lines 1-5).

In contrast to Harwood, in the present invention, a melt-blown, non-woven fabric can be obtained by extruding the branched or cross-linked PAS polymer alone. Therefore, one skilled in the art referring to Harwood would not be motivated to reach the invention defined in amended claim 1, and, accordingly, amended claim 1 is not obvious over Harwood.

With respect to Ikeda, Ikeda discloses a fabric composed of an extra fine fiber having a mean diameter of 0.1-8.0  $\mu\text{m}$  obtained by melt-blowing a linear polymer of polyphenylene sulfide (emphasis added) (see claim 1; column 3, lines 48-55, column 5, lines 24). Thus, Ikeda fails to teach a melt-blown, non-woven fabric obtained by extruding the branched or cross-linked PAS polymer alone.

As described in the specification of the present application, pages 2 to 3, when a linear polymer of polyphenylene sulfide is subjected to melt-blowing to obtain extremely fine fibers, there is a tendency to obtain fibers with less uniform diameters (see page 2, line 21 to page 3, line 1 of the specification). This is because branched or cross-linked PPS polymers have a high shear rate dependence, so that the melt viscosity of the polymers might be lowered at the time of extruding from a die to form extremely fine fibers. Further, one must maintain the state of fine fibers as such with increasing melt viscosity at the time of depositing the molten polymers on a rotating collector roll, while the substantially linear PAS polymers as disclosed in Ikeda form dripping molten polymers without decreasing their high fluidity. This is even if they are deposited on the rotating roll, because of their low shear rate dependence.

Therefore, one skilled in the art referring to Ikeda would not be motivated to reach the invention recited in amended claim 1, and, accordingly, amended claim 1 is not obvious over Ikeda.

With respect to Auerbach, Auerbach discloses melt-blown microfiber webs with diameters of 0.1-20  $\mu\text{m}$ , prepared from a mixture comprising a polyarylene sulfide polymer and an organic phosphite or phosphonite (see page 4, lines 3-7). Thus, although Auerbach teaches that a combined use of PPS polymers with a small amount of a specified organic phosphite or

phosphonite compound can suppress the formation of larger resin aggregates known as "spitters" (see page 2, lines 35-47, page 4, lines 5-11), Auerbach avoids the sole use of PPS polymers because of the formation of spitters (see page 4, lines 7-9) and is silent regarding the non-Newtonian coefficient of the PPS polymers used.

Therefore, one skilled in the art referring to Auerbach would not be motivated to reach the present invention defined in amended claim 1, and accordingly, claim 1 of the present application is not obvious over Auerbach.

Detailed discussion has already been given above with respect to, Fukata, Harwood, Ikeda and Auerbach. In summary, none of the cited references teaches a melt-blown, non-woven fabric having an average diameter of 10  $\mu\text{m}$  or less comprising polyarylene sulfide having a branched structure and a non-Newtonian coefficient of 1.05-1.20, which are the critical features of the present invention defined in amended claim 1. Therefore, even if Harwood, Ikeda, and Auerbach are combined with Fukata, one skilled in the art would not reach the present invention.

With respect to amended claim 18, although Harwood teaches melt blown fibers as a nonwoven web of fibers of a blend consisting of linear polyarylene sulfide and up to about 40% polyolefin by weight of the total blend (see column 4, lines 11-15, column 7, line 64 to column 8, line 11), Harwood is silent regarding any method for introducing a cross-linking structure into the PPS polymers.

Although Ikeda discloses a fabric composed of extra fine fibers having a mean diameter of 0.1-8.0  $\mu\text{m}$  obtained by melt-blowing a linear polymer of polyphenylene sulfide, Ikeda fails to teach a melt-blown, non-woven fabric of cross-linked PAS polymer alone.

Further, Auerbach teaches that: "The polyarylene sulfide may be cross-linked. It is preferably linear (see page 4, lines 40-44)." However, in Auerbach, since the addition of a specified organic phosphite or phosphonite compound is indispensable, Auerbach fails to disclose a method to produce the solely cross-linked PAS polymer as disclosed in the present application.

As is clear from the above discussion, none of the cited references teaches a melt-blown, non-woven fabric having an average diameter of 10  $\mu\text{m}$  or less comprising polyarylene sulfide having a cross-linked structure and a non-Newtonian coefficient of 1.05-1.20, which are the critical features of the present invention defined in amended claim 18. Therefore, even if each of Harwood, Ikeda and Auerbach were combined with Fukata, one skilled in the art would not reach the invention defined in amended claim 18.

With respect to amended claim 21, its patentability is clear not only from the above discussion concerning amended claim I but also the description on page 21, lines 8-11, and working Examples 1-4 in Table I of the specification.

Applicants now address the obviousness rejection further in view of Senga.

Amended claim 6 of the present application mandates: "The melt-blown, non-woven fabric having an average diameter of 10  $\mu\text{m}$  or less according to claim 1, wherein said polyarylene sulfide is a reaction product of an alkaline metal sulfide, a dihaloaromatic compound and a polyhaloaromatic compound having 3 or more halogen substituents in one molecule, and 0.01-0.3 mol %, based on 100 mol % of said alkaline metal sulfide, of said polyhaloromatic compound is added in the reaction".

Amended claim 8 of the present application mandates: "The melt-blown, non-woven fabric having an average diameter of 10  $\mu\text{m}$  or less according to claim 18, wherein said polyarylene sulfide is subjected to a thermal oxidation cross-linking treatment."

Further, claim 10 of the present application mandates "The melt-blown, non-woven fabric according to claim 8, wherein said thermal oxidation cross-linking treatment is carried out at 160-260°C for 1-120 hours."

With respect to amended claim 6, Senga certainly teaches that a molar ratio of the aromatic compound (C) having three or more than three functional groups to the dihalogen aromatic compound (B) [(C)/(B)] may range generally from 0.003/1 to 0.05/1 (see Abstract; claim 5 and page 6, lines 5-11). However, since Senga further teaches that a molar ratio of the dihalogen aromatic compound (B) to the metallic sulfide (A) [(B)/(A)] may range from 1.035/1 to 1.300/1 (see Abstract; claim 5 and page 6, lines 5-6), a molar ratio of the aromatic compound (C) to the metallic sulfide (A) [(C)/(A)] may range from 0.003105/1 to 0.065/1.

This molar ratio of the aromatic compound to the metallic sulfide ranging from 0.003105/1 to 0.065/1 of Senga is larger than the molar ratio of the polyhaloaromatic compound to the alkaline metal sulfide of 0.0001/1-0.003/1 derived from the amount of the polyhaloaromatic compound being preferably 0.01-0.3 mol % based on 100 mol % of the alkaline metal sulfide recited in amended claim 6.

Therefore, one skilled in the art referring to Senga would not be motivated to reach the invention defined in amended claim 6, and, accordingly, amended claim 6 is not obvious over Senga.

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Since, each of Fukata, Harwood, Ikeda and Auerbach is silent regarding the molar ratio of the polyhaloaromatic compound to the alkaline metal sulfide required for the preparation of PPS polymers, the inventive step of the invention defined in amended claim 6 of the present application is not suggested by Harwood, Ikeda and Auerbach, even if combined with Fukata and Senga.

In addition, with respect to amended claim 8, Senga is silent regarding any method for introducing cross-linking structure into the PAS polymers. Accordingly, Senga fails to teach the branched or cross-linked PAS polymer having a non-Newtonian coefficient of 1.05-1.20 of the present invention. Thus, one skilled in the art referring to Senga would not be motivated to the invention defined in amended claim 8, and, accordingly, amended claim 8 is not obvious over Senga

Therefore, amended claim 8, which depends from amended claim 8, is not obvious over Senga.

Accordingly, as is clear from earlier discussion, the inventive step of amended claim 8 is not suggested by each of Harwood, Ikeda and Auerbach, even if combined with Fukata and Senga.

With respect to claim 10, depending from amended claim 18, its patentability is clear from the above discussions concerning amended claim 18.

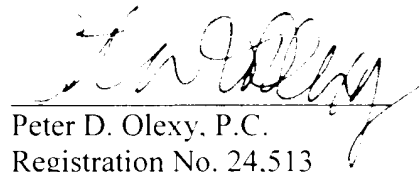
With respect to the rejection of claims 19-21, it is believed that the patentability of these is clear from the above discussion regarding amended claim 1.

Withdrawal of all rejections and allowance is requested.

RESPONSE UNDER 37 C.F.R. § 1.111  
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Respectfully submitted.



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